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COTTON/SILK BLENDS ON COTTON SPINNING PROCESS

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Abstract

After raw silk reeling in the silk industry, there remains 20-25% waste. This short silk fiber waste could be blended with other fibers, such as cotton fibers, to develop a new yarn with some new functional properties. Generally, there are three types of silk waste – inferior knobs, filature gum waste, and pierced cocoon – which correspond respectively with the outer, middle, and mixed layer of the cocoon. In this work, a complete study of blending is carried out in order to understand the influence of blending factors, which are the important parameters cited by Hamilton et al. (1958) for the blended yarn. The blending type in the spinning process, the silk waste types, and the silk content has affected on the silk/cotton blended yarn characterization. The distinctive properties of silk give to the blended yarn a higher tenacity and better evenness.

Introduction

In the production of raw silk, Thailand ranks as the fifth largest producer in the world (1000 tons/year in 2001). The 20-25% short silk fiber waste that remains after raw silk reeling in the silk industry could be blended with other fibers, such as cotton fibers, to develop a new yarn with some new functional properties. Generally, there are three types of silk waste – inferior knobs, filature gum waste, and pierced cocoon – which are related to the outer, middle and mixed layer of cocoon, respectively. In this study, the globally complete analysis of blending is carried out in order to understand the influence of blending factors, which are the important parameters cited by Hamilton et al. (1958) for the blended yarn.

Materials and Methods

Three Thai silk waste (Chul no.4 variety) were prepared in the spun silk industry (Chollakup *et al*., 2002). The Thai cotton, Dora 11, was selected to be blended with this silk waste. The physical properties of silk and cotton fibers are shown in Table 1. Two kinds of blending techniques -- intimate and drawframe blending -- have been carried out in the cotton spinning system to produce the blended yarns at the silk contents of 25%, 50%, and 75%, along with three types of pure silk yarn and cotton yarn as well as the cotton yarn of 30 tex yarn count with a twist factor α_{Nm} of 110 (Chollakup *et al*., 2003). The UT3 device was used to evaluate the yarn unevenness, whereas the Tensorapid instrument was used to investigate the mechanical properties. Also, all types of bundle fibers after passing in the last steps of drawing are characterized as to their physical properties, such as fiber length, tenacity, and elongation following the standard method in Table 1, as well as a cohesion of slivers (ASTM-D2612).

Results and Discussions

The global results of yarn unevenness and mechanical properties after a multi-factorial ANOVA (Table 2) show that the intimate blending provides more yarn regularity and resistance than the drawframe blending does. The presence of the silk softener in the drawframe blending yarns may yield to some relative fiber slippage more than fiber breakage during yarn rupture. This phenomenon yields to yarn tensile reduction in the case of drawframe blending. Concerning the silk type effect, the fiber fineness tends to decrease the yarn unevenness (CV%) and increase the tenacity. These results corroborate earlier study (Tsubouchi *et al* 1993) relative to the tenacity of 70/30 silk/cotton blending. Yarn evenness increases with the silk proportion. Matsumoto *et al.* (1991) found the same tendency in the blending of polyester/silk. This result constitutes an advantage for the presence of silk in blended yarn.

The correlation between the characteristics of the blended bundle fibers at the last passage of drawing process and those of the blended yarn is calculated by the stepwise multiple regression as shown in Table 3. It shows that there are two important sliver parameters affecting the yarn characteristics, the sliver cohesion and the bundle fiber tenacity. The sliver cohesion has the effect of reducing the yarn unevenness and increasing its tenacity.

Conclusion

The blending type in the spinning process, the silk waste types, and the silk content affected the silk and cotton blended yarn characterization. The distinctive properties of silk give to the blended yarn a higher tenacity and better evenness.

References

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Table 1. Physical properties of the silk waste and cotton fibers.

			Silk fiber		
		Cotton fiber[1] [HVI, FMT]	**Inferior knubbs (SK)**	**Filature gum waste (SW)**	**Pierced cocoon (SC)**
Length	Mean Length, ML (mm)	23.9 ± 0.6	21.1 ± 0.6	19.4 ± 1.6	24.8 ± 1.2
[Peyer's Almeter AL]	Upper Half Mean Length, UHML (mm)	28.6 ± 0.5	37.0 ± 1.6	36.2 ± 2.8	46.0 ± 1.2
Fineness [ASTM-D 2130]	Fineness (mtex)	175	139	168	160
Strength	Tenacity (cN/tex)	27.3 ± 1.0	23.9 ± 1.8	25.6 ± 1.4	23.2 ± 1.5
[ASTM-D	Elongation at peak (%)	5.4 ± 0.2	14.0 ± 0.9	13.6 ± 0.7	13.3 ± 0.9
2524]	Elongation at break (%)	-	24.7 ± 1.5	25.7 ± 2.1	25.8 ± 2.3

[1]Cotton fiber is measured by HVI and FMT.

Table 2. Multi-factorial ANOVA of three blending factors and One-Way ANOVA of the pure components on the 30-tex yarn characteristics.

	Three Factorial ANOVA								One way ANOVA			
	Blending		**Silk wastes**			**Silk proportions**			**Pure components**			
	Int	**Dr**	**SK**	**SW**	**SC**	**25**	**50**	**75**	**SK**	**SW**	**SC**	**C**
CV%	14.71 ^{a}	15.69 ^{b}	14.40 ^{a}	16.49 ^{b}	14.71 ^{a}	15.46 ^{b}	15.16 ^{ab}	14.71 ^{a}	14.91 ^{ab}	18.18 ^{c}	14.02 ^{ab}	15.36 ^{b}
Hairiness	7.44 ^{a}	7.63 ^{b}	7.21 ^{a}	7.84 ^{c}	7.57 ^{b}	7.20 ^{a}	7.64 ^{b}	7.77 ^{b}	7.66 ^{b}	8.75 ^{d}	8.30 ^{c}	6.99 ^{a}
Tenacity, cN/tex	14.67 ^{a}	13.82 ^{b}	15.12 ^{a}	13.36 ^{c}	14.25 ^{b}	13.31 ^{b}	13.75 ^{b}	15.67 ^{a}	15.96 ^{a}	16.71 ^{a}	16.63 ^{a}	13.79 ^{b}
Elongation %	6.29 ^{ns}	6.30 ^{ns}	6.52 ^{a}	5.97 ^{b}	6.40 ^{a}	5.82 ^{c}	6.21 ^{b}	6.87 ^{a}	7.68 ^{a}	7.37 ^{a}	7.77 ^{a}	5.78 ^{b}

The letter *a* signifies the best quality in terms of the yarn characteristics compared to *b* and *c* respectively at $p \leq 0.05$ for each factor, One-Way ANOVA is carried out for pure components. *ns* means no significant difference.

Table 3: The influences of bundle fiber characteristics on the blended yarn quality.

Yarn characteristics	Characteristics of fiber bundles UHML	Tenacity	Cohesion	Elongation at peak
CV%	0	++	---	0
Hairiness	+	+	--	0
Tenacity	0	0	+++	0
Elongation	++	0	0	0

0 means no significant or neglected influence during stepwise multiple regression; + or - means positive or negative significant influence at $p \leq 0.10$ ++ or - - means significant influence at $p \leq 0.05$; +++ or - - - means significant influence at $p \leq 0.01$.